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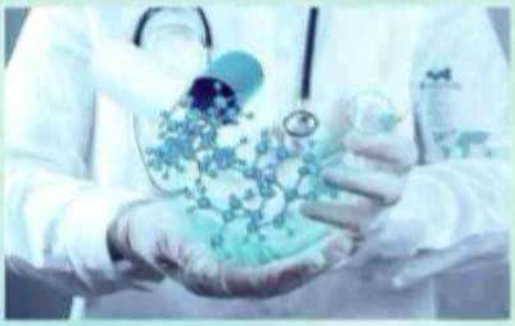

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MODERN APPROACHES AND ONGOING CHALLENGES IN MANAGING CLEFT LIP AND PALATE PATIENTS: A COMPREHENSIVE REVIEW

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✓ ***Resume***

Cleft lip and cleft palate represent some of the most prevalent congenital malformations of the oral cavity, with incidence rates varying across populations. Their etiology is multifactorial, influenced by both genetic predispositions and environmental factors. The objective of this narrative review is to examine the pediatric population with cleft lip and/or palate as a primary focus for interdisciplinary treatment. This review summarizes current knowledge on treatment approaches for cleft patients and underscores the essential need for close collaboration among dental specialists and medical professionals. Effective management requires the combined expertise of oral surgeons, prosthodontists, orthodontists, pediatricians, speech therapists, phoniatricians, and otolaryngologists to ensure comprehensive care.

Keywords: cleft lip, cleft palate, interdisciplinary treatment, orthodontics, pediatric care.

СОВРЕМЕННЫЕ ПОДХОДЫ И АКТУАЛЬНЫЕ ПРОБЛЕМЫ В ЛЕЧЕНИИ ПАЦИЕНТОВ С РАСЩЕЛИНОЙ ГУБЫ И НЁБА: КОМПЛЕКСНЫЙ ОБЗОР

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✓ ***Резюме***

Расщелина губы и нёба относятся к числу наиболее распространённых врождённых аномалий полости рта, при этом частота их встречаемости варьирует в разных популяциях. Этиология данных пороков является многофакторной и определяется как генетической предрасположенностью, так и воздействием факторов окружающей среды. Целью данного обзорного исследования является рассмотрение педиатрической группы пациентов с расщелиной губы и/или нёба как основной категории, требующей междисциплинарного подхода в лечении. В обзоре обобщены современные данные о методах лечения пациентов с расщелинами и подчёркнута необходимость тесного взаимодействия стоматологов и врачей смежных специальностей. Эффективное ведение таких пациентов требует совместной работы челюстно-лицевых хирургов, ортопедов-стоматологов, ортодонтов, педиатров, логопедов, фониатров и оториноларингологов для обеспечения комплексной помощи.

Ключевые слова: расщелина губы, расщелина нёба, междисциплинарное лечение, ортодонтия, педиатрическая помощь.

Introduction

Cleft lip and/or palate (CLP) ranks among the most common congenital malformations, with isolated forms observed in approximately 1.7 per 1,000 live births. The etiology of clefts is complex and multifactorial, involving both genetic and environmental influences. Beyond hereditary factors, epidemiological studies emphasize the role of environmental exposures such as maternal smoking, alcohol use, certain medications, and inadequate folic acid intake. The incidence of CLP also

varies across ethnic groups and geographical regions. While the majority of cases are unilateral, bilateral clefts are also frequently encountered [1–3].

CLP develops in utero as a disruption of normal embryogenesis. Under typical conditions, the palatal shelves approach and fuse between the 5th and 12th weeks of gestation. Disturbances in mesenchymal and endodermal cell proliferation during this period can result in cleft formation [4]. Clefts are commonly classified into cleft lip (CL), cleft lip and palate (CLP), and cleft palate only (CPO). Cleft palate may range from partial soft tissue involvement to extension as far as the uvula [4]. Isolated cleft lip accounts for about 15% of cases, while isolated cleft palate represents approximately 40% [6].

The purpose of this narrative review is to emphasize the lifelong medical care required by individuals with CLP and to highlight the necessity of multidisciplinary collaboration in their management. Patients often experience a broad spectrum of functional impairments, including difficulties with breathing, swallowing, sucking, chewing, speech, and hearing [7]. Treatment typically involves surgical interventions, orthodontics, otolaryngology, and speech therapy, while genetic counseling and psychological support have become essential components of modern care [8–10].

Given the diversity of procedures and specialists involved, a coordinated approach is crucial. Ideally, a designated care leader would oversee the treatment process, monitor patient progress, and provide timely referrals to other specialists. This raises two critical questions central to this review: What are the optimal treatment steps for patients with clefts? And should a single coordinator be appointed to guide and unify the treatment pathway?

2.Inclusion and Exclusion Criteria

A comprehensive search was conducted across three databases—PubMed, Google Scholar, and Cochrane—to gather the most up-to-date literature on the treatment of cleft lip and palate. The search strategy combined the keywords cleft lip and/or cleft palate with terms such as multidisciplinary treatment, multidisciplinary approach, surgical treatment, dental treatment, orthodontic treatment, and medical care.

Eligible studies included peer-reviewed original research articles and review papers published in English. Preference was given to studies published within the last 10 years to ensure contemporary relevance, provided the scientific foundation was clear and reliable. Case reports were included only when they presented novel treatment methods or approaches with potential clinical impact.

The focus was placed on studies with practical implications and clinical significance, particularly those addressing multidisciplinary care pathways. Figure 1 outlines the primary inclusion criteria applied in this review. The goal was to capture a broad yet meaningful overview of treatment modalities relevant to patients requiring integrated, interdisciplinary management.

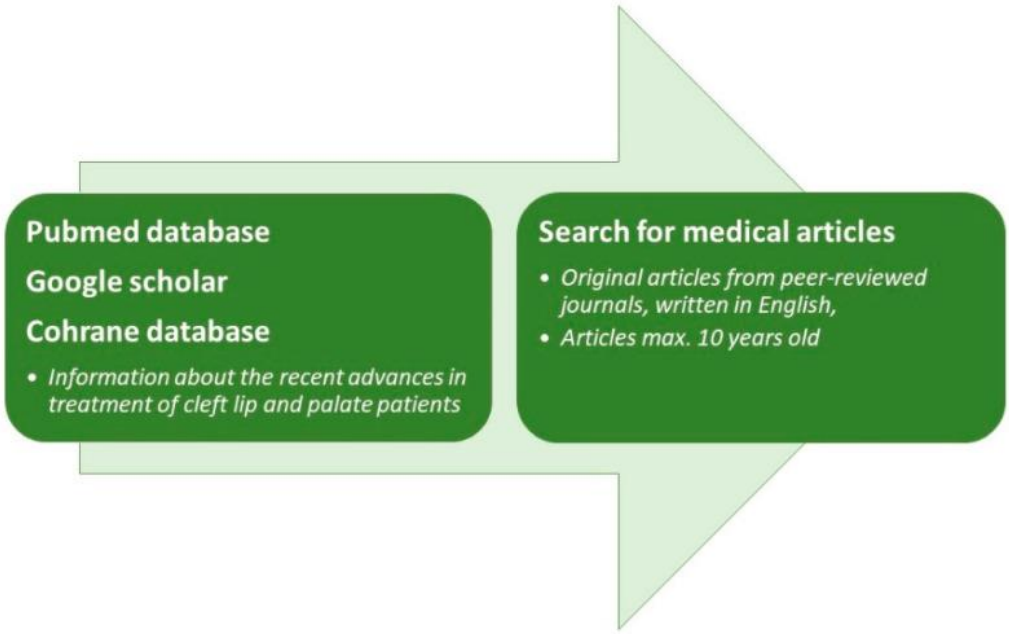

Figure 1. The inclusion criteria of papers incorporated to the study.

3. Latest Advances in the Treatment of Cleft Lip and/or Palate

3.1. Early Presurgical Interventions

One of the key presurgical procedures is *presurgical nasoalveolar molding* (PNAM, also known as Figueroa's NAM technique), first introduced by Grayson in 2004 [11]. PNAM reduces cleft-related deformities, particularly in the nasal and lip regions. Clinical observations demonstrate decreased columella width, increased columella height, reduced bi-alar width, and improved nasal symmetry [12,13].

Presurgical preparation often involves the use of a NAM plate, an acrylic orthodontic appliance designed to stimulate maxillary growth and redirect craniofacial development in cleft patients. Modern NAM plates are frequently fabricated using 3D printing technology. These plates assist in rotating the premaxilla, reducing the width of the cleft fissure, and altering maxillary width in the canine and molar regions [14,15]. For maximum effectiveness, treatment should begin as early as possible, though adaptation in neonates can be challenging. Once in place, the plate must be worn continuously, with only short breaks for cleaning twice daily [13].

NAM therapy also influences the rotation of the incisal bone, leading to a more natural alveolar arch form and spontaneous narrowing of the cleft gap [12]. While long-term follow-up indicates stable improvements in dental arch shape, other craniofacial abnormalities often persist [16]. Additional soft tissue mobilization techniques—such as lip massage and lip taping—may be applied to improve elasticity and facilitate soft tissue closure over the alveolar defect [17,18].

3.2. Surgical Closure of the Lip and/or Palate

The initial surgical interventions for cleft patients include *cheiloplasty*, *palatoplasty*, and, later, *alveolar bone grafting*. In most countries, lip repair is performed between 3–6 months of age, while palatal closure is carried out between 6–18 months [19,20].

A novel *C-flap technique*, introduced by Jung et al. [18], allows for the creation of a longer lip, reducing deformities in the philtrum and Cupid's bow compared to traditional approaches. The surgical method selected depends on cleft type and surgeon experience. Commonly, Fischer's technique and the modified Millard rotation-advancement flap remain the preferred options for lip repair [21–23]. For palatal closure, nonradical intravelar veloplasty is among the techniques available to restore velar function [24].

Postoperative care is essential to minimize complications, focusing on scar management through massage, monitoring for wound dehiscence, and the use of silicone gels or steroid applications [19]. More recently, laser therapy has been introduced to soften and flatten scar tissue, improving aesthetic outcomes [25].

3.3. Alveolar Bone Grafting

In patients with alveolar clefts, bone grafting is frequently required to restore bone continuity, support tooth eruption, and enable future prosthetic rehabilitation. The timing of grafting remains debated, but it is commonly performed during the mixed dentition stage. The iliac crest is the most widely used donor site due to its abundant cancellous bone supply (up to 50 mL), although calvarial bone may also be used. Autologous bone remains the gold standard grafting material [19,26–28].

Care must be taken to handle graft material gently, as crushing increases resorption and reduces graft volume and stability. Beyond dental support, grafting also contributes to nasal base reconstruction and correction of alveolar collapse [7].

Recent advances include the use of *3D planning technologies* to customize grafts for precise anatomical fit [29]. In addition, 3D-printed bio-glass scaffolds are emerging as promising alternatives for alveolar reconstruction [8]

4. Genetic Basis of Cleft Lip and/or Palate

Genetic factors play a fundamental role in the development of cleft lip and/or palate, particularly in non-syndromic cases. Several genes have been consistently associated with cleft formation, including *CDH1* (16q22.1), *COL2A1* (12q13.11), *CRISPLD2* (16q24.1), *FOXE1* (9q22.33), *GRHL3* (1p36.11), *IRF6* (1q32.2), *JAG2* (14q32.33), *MSX1* (4p16.2), *PAX7* (1p36.13), *ROCK1* (18q11.1), *SUMO1* (2q33.1), *TBX22* (Xq21.1), *TCOF1* (5q32–q33.1), and *TGFA* (2p13.3) [4,24].

Understanding these genetic associations is not only critical for clarifying etiology but also for informing reproductive counseling. Knowledge of specific mutations allows families to make more informed decisions about future pregnancies, and prenatal diagnostic testing can play an essential role in early detection. For example, mutations in *PAX9* and *MSX1* genes are linked to hypodontia, making it possible to anticipate dental anomalies even before birth [30–32].

Ongoing genetic studies continue to shed light on cleft pathogenesis and its frequent association with dysmorphic features. Such insights can enhance individualized treatment strategies and enable clinicians to anticipate potential comorbidities. A deeper understanding of genetic predispositions also opens possibilities for targeted therapies and preventive measures.

While genetic engineering is a topic of increasing discussion in scientific circles, its application in preventing cleft formation remains speculative. Although future advances may eventually allow for the correction of mutations responsible for clefts, the authors emphasize caution when projecting such outcomes, particularly in the near term.

5. Multidisciplinary Teams in the Diagnosis and Treatment of Cleft Lip and/or Palate

5.1. Pediatrician

Pediatric care begins immediately after the diagnosis of cleft lip and/or palate. Newborns often struggle with feeding due to the absence of an effective lip seal and the inability to generate intraoral pressure, caused by the cleft in the lip or palate. As a result, infants are unable to suck through a standard nipple and typically require specialized feeding devices, which should be provided before discharge from the neonatal hospital [6].

In addition to managing feeding and general health, the pediatrician may serve as the coordinator of the interdisciplinary team, ensuring proper timing of specialist interventions. They also provide psychosocial support to families, particularly in addressing communication-related concerns and helping parents navigate the emotional challenges associated with cleft care [33].

5.2. Speech Therapy and Phoniatrics

Children with clefts frequently present with impaired speech due to muscular dysfunction, particularly of the *levator veli palatini* muscle. This often results in delayed acquisition of consonant sounds such as *p, b, t, d, k,* and *g*. Velopharyngeal dysfunction (VPD) is commonly observed, leading to hypernasality, compensatory articulation errors, and abnormal air emission patterns. Nasal resonance and articulation difficulties are therefore characteristic features [6,34].

Epidemiological studies indicate that nasal speech occurs approximately twice as often in children with clefts compared to their unaffected peers [35]. Although more than 60% of cleft patients eventually achieve intelligible speech, over 70% require structured speech therapy during development [36].

Speech therapists, in collaboration with otolaryngologists, must carefully differentiate between obligatory nasal emission (caused by structural deficits) and compensatory patterns or misarticulations, in which pharyngeal sounds replace oral ones. Accurate diagnosis is essential to determine whether speech problems arise from velopharyngeal insufficiency or articulation errors [37].

Surgical interventions may be indicated to improve velopharyngeal function. Furlow's double-opposing Z-plasty (Furlow palatoplasty) is widely regarded as the procedure of choice for lengthening the soft palate [38]. Importantly, both primary and secondary palatoplasty have been shown to yield comparable results in improving speech outcomes [39].

5.3. Otolaryngologist (Laryngologist)

Otolaryngological problems in cleft patients most often involve recurrent middle ear infections, which can lead to varying degrees of hearing loss. The underlying mechanism is related to dysfunction of the *levator veli palatini* muscle, responsible for opening the Eustachian tube. As a result, middle ear effusion is frequently present from birth, and newborns may fail initial hearing screenings.

To evaluate nasal patency and monitor airway changes after multiple surgical interventions, acoustic rhinometry can be used. This method provides valuable information on nasal obstruction and helps determine the need for surgical reconstruction. Among surgical procedures performed during

adolescence, rhinoplasty is common, with rib grafts serving as the primary donor material for restoring nasal shape, projection, and width. Nasal osteotomy is the second most frequently used approach.

5.4. Dentistry

Children with cleft lip and/or palate commonly present with multiple dental anomalies, affecting tooth number, morphology, and eruption timing. Neonatal teeth are relatively common, while microdontia or agenesis of the maxillary lateral incisors are frequent findings. Ectopic eruption, particularly of canines into the palatal side, as well as delayed eruption and enamel hypoplasia, are additional challenges. Supernumerary teeth occur in roughly one-quarter of patients and are thought to result from disturbances in the dental lamina during prenatal development. Notably, anomalies are most often localized to the cleft side.

Prior to reconstructive surgery, pediatric dentists play a crucial role in advising families on diet and oral hygiene. Following surgery, preventive measures such as topical fluoride and sealant applications are recommended, with fluoride ideally administered at least twice a year.

Oral hygiene among children with clefts is often compromised, which, when combined with enamel hypoplasia and surface opacities, increases susceptibility to dental caries. Tooth hypoplasia has been linked both to the palatal defect itself and to the number and type of surgeries performed. Preventive strategies against early childhood caries are essential, and when necessary, restorative and endodontic treatments must be carried out.

Although gingival recession is not typically observed, the keratinized gingiva around the cleft area tends to be thinner. Regular dental check-ups are especially important during active orthodontic treatment with fixed appliances, as maintaining oral hygiene becomes more challenging at that stage. Pediatric dentists not only provide preventive and restorative care but may also serve as key coordinators within the multidisciplinary team, guiding treatment planning and ensuring continuity of care.

5.4.1. Orthodontic Procedures

Orthodontic problems are common in patients with cleft lip and/or palate and often necessitate subsequent orthognathic surgery. The most frequent malocclusions observed are crossbites and partial open bites, particularly on the side of the surgical intervention.

According to Angle's classification, Class I malocclusions are most common; however, unlike the general population, there is a higher prevalence of Class III malocclusions in cleft patients. These cases are often characterized by pseudomesial occlusion associated with maxillary hypoplasia. In contrast, Class II malocclusions, which are more common in healthy individuals, occur significantly less frequently in cleft patients. Some studies suggest that hypoplasia is not limited to the maxilla alone but involves the entire midface complex.

For the assessment of dentoalveolar relationships and treatment planning, the GOSLON Yardstick is widely used. This five-grade index categorizes malocclusions and assists in determining the severity of the deformity and corresponding treatment needs. Approximately 60–70% of cleft patients are classified as GOSLON grade 3 or higher, indicating moderate to severe orthodontic treatment requirements.

Table 1. GOSLON Index — Division, Description, and Treatment Needs

GOSLON Scale	Meaning	Treatment Needs
GOSLON 1	Isolated dental anomalies	Orthodontic treatment could be performed due to esthetic reasons
GOSLON 2	Lateral crossbite, palatotrusion of upper incisors	Removable and fixed appliance treatment
GOSLON 3	Lateral crossbite, tête-à-tête occlusion of the incisors; possible complete crossbite of one half of the arch	Removable and fixed appliance treatment with additional transpalatal bars and hyrax appliance
GOSLON 4	Severe malocclusion with crossbite on the bone basis	Orthognathic surgery; MARPE
GOSLON 5	Severe malocclusion with crossbite on the bone basis with additional open bite	Orthognathic surgery

The treatment of cleft patients is a prolonged and complex process, often beginning in early childhood and extending for nearly a decade or more. On average, treatment for unilateral clefts lasts over nine years, while bilateral cleft cases typically require more than ten years of continuous care. Orthodontic management involves both removable and fixed appliances. Removable devices are frequently used to create or maintain space in the dental arch, especially in cases of premature tooth loss. These appliances often incorporate transverse expansion screws to achieve the necessary adjustments.

Recent advances in orthodontic diagnostics increasingly rely on 3D dental scanning. This technology is particularly valuable for cleft patients, as it provides precise imaging of the dental arch. Consequently, customized appliances can be fabricated with improved accuracy, ensuring a better fit and more effective treatment outcomes.

5.4.2. Prosthodontics

Prosthodontists play an essential role within the cleft care team, as the final esthetic outcome of treatment—particularly the naturalness and attractiveness of the smile—depends heavily on prosthodontic expertise. Historically, restorative options were limited to veneers, crowns, bridges, and removable prostheses to address malformed or missing teeth.

Today, dental implants are considered the gold standard for replacing missing teeth in cleft patients. Survival rates for implants placed in sites previously reconstructed with alveolar bone grafts are high, though long-term esthetic outcomes still require careful monitoring. One challenge lies in "pink esthetics," as individuals with clefts often present thinner gingival margins and reduced bone levels, which can compromise the appearance of the peri-implant tissues. Nevertheless, functional implant parameters remain comparable to those observed in non-cleft populations. The most favorable results are reported when bone grafting is performed approximately three months prior to implant placement, allowing for better stability and integration.

5.4.3. Plastic and Orthognathic Surgery

Plastic and orthognathic procedures are typically performed in adulthood as part of the final stages of cleft care. They may include lip revision to refine labial contour, secondary palatoplasty to correct velopharyngeal dysfunction, correction of maxillary hypoplasia, rhinoplasty, and surgery for velopharyngeal incompetence. These interventions are particularly important in improving speech quality, as patients with clefts often exhibit characteristic nasal resonance that requires enhancement of velopharyngeal function for normalization.

Maxillary hypoplasia represents one of the most visible stigmata of cleft deformities. Treatment options include the use of oral distractors or orthognathic surgery, both aimed at reducing facial asymmetry and improving function. Osteotomy—most commonly the Le Fort I procedure—is performed to enhance both facial esthetics and quality of life. Ideally, osteotomy is combined with bone grafting to minimize postoperative velopharyngeal dysfunction. However, patients should be counseled in advance that additional surgical interventions may be necessary to further improve speech outcomes. Many individuals also opt for simultaneous rhinoplasty during Le Fort I surgery, with revision rhinoplasty in cleft patients often requiring cartilage grafts for optimal results.

6. Other Treatment Needs

Beyond surgical and dental procedures, cleft patients face additional challenges that affect both function and psychosocial well-being. The combination of facial deformity, recurrent discomfort, and the need for multiple repair surgeries can significantly influence self-image and social interactions. Many patients express a strong desire to improve their appearance, sometimes turning to social media platforms where they use positive language, such as "beauty," to redefine their identity and gain acceptance. Psychological support is therefore a crucial component of comprehensive cleft care.

Interestingly, studies show that improvements in smile and occlusion through orthodontic treatment provide cleft patients with quality-of-life benefits comparable to those experienced by individuals without clefts.

Functional concerns also remain prominent. Patients often experience overload of the masticatory muscles, requiring a combination of orthodontic, prosthetic, and physiotherapeutic management. Ideal treatment planning should include the use of facebows and articulators to ensure proper occlusion, balanced distribution of bite forces, and prevention of excessive stress on the temporomandibular joint. This careful approach helps restore efficient function while protecting long-term oral health.

7. Discussion

Patients with clefts require comprehensive, lifelong multidisciplinary care. Understanding the complexity of orofacial deformities in this group reinforces the necessity of collaborative treatment approaches. Among the most common malocclusions are crossbites and open bites, particularly on the cleft side. These malocclusions largely stem from maxillary hypoplasia.

Although patients typically undergo multiple reconstructive interventions—including lip repair, palatal closure, bone grafting, and subsequent plastic surgeries—the success of treatment ultimately depends on orthodontic and orthognathic preparation. The absence of a proper palatal suture and the presence of scarring on the palate frequently cause mesial rotation of the palatal bone, particularly in the anterior region. To improve stability of the maxillary complex after orthognathic procedures in adulthood, maxillary segmentation is often required. Additionally, evaluating both vertical and sagittal jaw relationships is essential for a full three-dimensional understanding of the malocclusion.

Beyond reconstruction and surgical interventions, patients also depend heavily on specialists who support functional development. Speech therapists, otolaryngologists, and phoniatricians play critical roles in managing speech outcomes and reducing the characteristic nasality associated with clefts. At the same time, dental anomalies necessitate the involvement of pediatric dentists, orthodontists, and often prosthodontists to achieve the most symmetrical and natural esthetic results possible.

Strong cooperation within the treatment team is indispensable. Structured treatment programs that bring together a network of specialists have been shown to benefit patients greatly. Such programs help standardize care pathways, keep patients and families well-informed, and make collaboration across specialties more efficient. They also create opportunities for integrating novel treatment methods in a coordinated manner.

The question of leadership within the multidisciplinary team is important. While opinions may differ on who should take on this role, it is clear that a leader is necessary to coordinate care, facilitate communication, and ensure continuity. The leader’s task is to weave together the expertise of various specialists and ensure that care remains patient-centered. Evidence-based medicine demonstrates that higher levels of experience among providers are linked with better patient outcomes, a principle that applies strongly in the context of cleft care.

8. Conclusions

In summary, clefts are among the most common congenital malformations and require a multidisciplinary, long-term approach. Multiple reconstructive and plastic surgeries are necessary to restore tissue continuity and correct functional impairments. Treatment begins in the neonatal period and extends into adulthood, involving frequent interventions by a wide range of specialists.

Because systematic follow-up is required at least twice a year, it is crucial to appoint a leader who can coordinate care and refer patients to the appropriate specialists when needed. This leader may be a pediatrician, dentist, or orthodontist, depending on the healthcare setting. What is most important is that the role ensures continuity, communication, and integration of care across disciplines, enabling the best possible outcomes for patients with clefts.

9.Limitations

The primary limitation of this review lies in the use of only three databases for the literature search. This decision was made deliberately, as the nature of the study did not allow for a full systematic review or meta-analysis. The authors acknowledge that the scope could be broadened, and indeed, each section of this review could serve as the foundation for a separate, more detailed paper.

Another limitation is that the perspective of this work is shaped largely by the authors’ professional expertise in dentistry and orthodontics. Since these areas form the core of the authors’ clinical experience with cleft patients, the emphasis of the review may reflect this background.

Nevertheless, the study incorporates both clinical observations and treatment frameworks, aiming to provide a practical overview of current approaches

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